Aalto University
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Political uncertainty and FX volatility during US presidential elections: Evidence from prediction market

Bachelor's Thesis, Finance

Abstract

This paper studies the effects of political uncertainty on the conditional volatility of the return on the Trade Weighted US Dollar Index during the homestretches of the last seven US presidential elections. Using daily probability data drawn from the Iowa Electronic Markets, I document that, first of all, higher uncertainty about the election outcome is attributed to a higher volatility of the US Dollar. Secondly, my empirical findings suggest that higher probabilities for a Republican candidate might decrease the volatility. Thirdly, I conclude that the volatility of the US Dollar is higher during the elections which lead to a change in political control between the parties, and in which there is no incumbent candidate running for the presidency. Overall, the findings of my thesis shed light on the connection between market anxiety and the uncertainty that surrounds political elections, and imply that the foreign exchange rates react to the changing betting odds of the US presidential elections.

Keywords:

FX volatility, Political uncertainty, Prediction markets, US presidential elections

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1. Introduction

While populist movements are rising all over the Western World, traditional opinion polls have time after time failed to predict the results of groundbreaking political elections. The uncertainty surrounding the elections has swayed foreign exchange rates remarkably during the recent years. For instance, in June 2016 right after the Brexit vote, at the worst point the Pound sterling had tumbled 11.1% against the US Dollar during the course of one day[1], and on the 9th of November in 2016, a day after the US presidential election, the Mexican peso had dropped by 13.4% against the US Dollar[2]. Those reactions were just a tip of an ice berg, though: Political uncertainty has also deeper long term effects on the economy and financial markets through macroeconomic factors and investors' expectations about the future economic policy (Lobo and Tufte, 1998). This creates an incentive for market players to understand the very nature of political uncertainty and how it transmits to the foreign exchange during election seasons. In addition, FX rates affect consumption, investment and income levels through export and import prices, and thus their stability is crucial from the perspective of common well-being.

Earlier studies have been able to draw a link between measures of political uncertainty and stock market return and volatility (see e.g. Lobo and Tufte 1998; Bialkowski et al. 2008; Pástor and Veronesi 2013; and Smales 2014). Goodell and Vähämaa (2013) use US presidential election betting odds to model the impact of election uncertainty on VIX volatility index finding a positive relationship between changes in the volatility and changes in the probabilities. Various studies have also provided evidence about the presence of partisan effect in the financial markets (see e.g. Hibbs 1986; Snowberg et al. 2007; Alvarez-Ramirez et al. 2012; Smales 2014; Dettrey and Palmer 2015). For instance, Snowberg et al. (2007) document that the election of a Republican president raises the value of equities by 2-3%.

However, there are extremely few studies that have focused on the impact that political uncertainty has on foreign exchange rates, and actually, there are no earlier studies that utilize prediction market data to consider how the changing probabilities of the election outcome transmit to the foreign exchange in form of anxiety. Therefore, it is of interest to study how the public uncertainty about the elections affects the FX volatility.

[1] Financial Times: www.ft.com/content/50436fde-39bb-11e6-9a05-82a9b15a8ee7 (22.4.2017)
[2] Financial Times: www.ft.com/content/e70025d2-a628-11e6-8898-79a99e2a4de6 (22.4.2017)

In this paper, I study how the evolving public opinion about the US presidential election candidates influences the conditional volatility of the Federal Reserve's Trade Weighted US Dollar Index. In particular, I am interested in finding out how different election characteristics, such as incumbency or partisan effects, affect this relationship. To this end, I use daily probability data drawn from the Iowa Electronic Markets from the last conclusive months of the seven most recent US presidential elections. I conclude that FX market reactions are the stronger, the higher the uncertainty about the election outcome is. The volatility tends to increase also in the the elections where the control shifts between the political parties. In addition, it appears that that the rising probabilities of a Republican candidate might decrease the conditional volatility of the US Dollar, and the FX markets would thus favor Republicans. Overall, my results suggest that political uncertainty transmits to the foreign exchange, and thus the elections might endanger the stability of the foreign exchange rates.

The rest of this paper is structured as follows: Section 2 reviews the earlier academic literature relating to the subject and presents the research hypothesis. Section 3 describes the data set and variables used in my empirical analysis. Section 4 explains the methodology used. Section 5 presents my empirical results. Section 6 discusses the results combining them to the existing literature, and finally, Section 7 sums up the conclusions of my study.

2. Literature review and hypothesis

As Lobo and Tufte (1998) point out, political uncertainty has two channels through which it transmits to the foreign exchange: through economic factors, and through investors' expectations about future policy changes. Thus, I will first discuss the two-sided relationship between political uncertainty and the economy in Section 2.1. After that in Section 2.2, I will review the partisan theory and discuss how certain market phenomena have been explained with it. Finally, in Section 2.3, I will discuss how the political uncertainty transmits to the financial markets in form of anxiety – i.e. as increased volatility.

2.1 Political risks and the economy

Government intervention is widely recognized as one of the most significant determinants of future economic conditions and activity. Thus, as politics affects the economy, and the economy affects the financial markets, there must be a political factor in the risk premium that varies as the probability of

political change fluctuates. Pástor and Veronesi (2013) provide evidence that while the political risk premium is in general larger during weaker economic conditions, its impact-shock component is greater during times of strong economy. This can be attributed to the 'meta moral hazard' theory (Miller et al. 2002): investors might rely on government to successfully intervene if markets fall – but not to stop them from rising. This creates a bubble to the market in a form of a too low risk premium as investors falsely believe there to be a put option, such as "the Greenspan put", that would protect them from crashes (Miller et al. 2002; Pastor and Veronesi 2013). Thus, overconfidence on the political stability might eventually lead to a crash as politics, by its nature, involves uncertainty.

Various studies (see e.g. Lobo and Tufte 1998; Snowberg et al. 2007; Bialkowski et al. 2008; Goodell and Vähämaa 2013; Pástor and Veronesi 2013; Smales 2014) have been able to link the level of political uncertainty to stock and bond market returns and volatilities. Julio and Yook (2012) document interestingly how the uncertainty about the future public policy affects companies' investment expenditures: on average, the value of firms' investments is 4.8% less during an election year compared to other years, and the trend is even clearer when the eventual winner does not reach a large margin. Thus, the level of political uncertainty is perceived by the real economy, as well as the financial markets, and even the uncertainty in itself is enough to affect the real economy before any policy change actually takes place.

The relationship between politics and the economy is two-sided, though. Economic conditions are proven to affect voting behavior (see e.g. Fair 2009) which creates an incentive for politicians to manipulate the election results by implementing policies that are not optimal in the long run but instead appeal to their supporters. This leads to a phenomenon called the political business cycle theory (Nordhaus 1975; Hibbs 1977). According to it, the economy grows faster during election seasons but contracts afterwards – which is explained by politicians' opportunistic behavior. As Goodell and Vähämaa (2013) point out, it is possible to attribute this phenomenon to the partisan theory (see Section 2.2), too.

2.2 The partisan effect in financial markets

Partisan effect refers to the differences between political parties and the effect that their policies generate. Various studies have documented differences in the returns of stocks and bonds in the United States between Republican and Democratic administrations (see e.g. Hibbs 1986; Snowberg et al. 2007;

Alvarez-Ramirez et al. 2012; Dettrey and Palmer 2015). Johnson et al. (1999) provide mixed results, though. They do not find any evidence that large-cap stocks would be exposed to the partisan effect, but they state that small-cap stocks tend to do better under Democratic administrations whereas the bond market benefits from a Republican rule.

Above differences in returns can be explained by the parties' dissenting economic policy goals. Hibbs (1986) argues that Republicans focus on keeping the inflation under control while Democrats tend to implement more expansionary policies in order to lower unemployment and stimulate growth. Dettrey and Palmer (2015) find similar results and specify that the economic growth is distributed through different channels under Democratic and Republican administrations. However, as Hibbs (1986) points out, it is difficult to precisely determine to what extent the inflation rate is determined by (a) politicians' actions and (b) the Federal Reserve's "independent" anti-inflation operations.

If the partisan effect is present in the US economy as described above, any new and significant information about changing political control should be reflected to efficient markets. Snowberg et al. (2007) analyze changes in central economic indicators during both the election day and season. They conclude that the election of a Republican president raises the value of equity markets by 2-3 percent and the positive reaction is stronger when the uncertainty element in the elections is higher. Also, the bond yields go up as a response to a Republican being elected.

But what kind of evidence about the partisan effect is there in the currency market? If Republicans are proven to focus on low inflation goals, then it would only be natural that the US dollar would likely appreciate when a Republican wins an election. However, it is common knowledge that future exchange rates are hard to predict and other factors, such as GDP growth and relative interest rates, affect them remarkably, too. This might be one of the reasons why there appears to be little recent study about the partisan effect and foreign exchange market. Chrétien and Coggins (2009) study Canadian market responses to election – both US and Canadian – and although they did not find evidence that the Canadian markets would prefer Conservatives over Liberals in the long run, they observed some differences in money market returns. Also, they document that the Canadian dollar is significantly stronger against the US dollar when the White House belongs to a Republican instead of a Democrat. Lobo and Tufte (1998), in turn, examine USD relative to JPY, GBP, DEM (German Mark) and CAD during five US presidential

terms in the late 20th century with mixed results. They find evidence about the partisan effect on the return on USD/JPY and GBP/USD but not on the return on USD/DEM or USD/CAD. The volatility of all the FX rates (except for CAD) was affected by the party-in-power. However, the effect was not co-directional as the volatility of GBP increased during the Republican rule whereas Democratic administrations had a similar effect on JPY and DEM

2.3 Political elections and volatility in financial markets

So far I have discussed the relationship between political power and the economy and reviewed how this relationship is reflected to the markets. In this section, I am focusing on the uncertainty that is present in both the political elections and financial markets in order to draw a link between the two. There are some previous studies that have connected different kinds of measures of political uncertainty to the volatility of equity markets. For instance, Bialkowski et al. (2008), Pástor and Veronesi (2013) and Smales (2014) have provided evidence that as political uncertainty increases, the volatility of stocks increases as well. This relationship is valid also outside of the US: Bialkowski et al. (2008) study a sample of 27 OECD countries, while Smales' (2014) research regards the Australian equity and bond markets.

Goodell and Vähämaa (2013) examine how the changing probabilities in the US presidential elections affect the implied volatility measured by VIX volatility index. Interesting is that they draw the probability data from a prediction market - in this case the Iowa Electronic Markets – where the probabilities are formed by market mechanism rather than by traditional opinion polling. Surprisingly, they conclude that there is a positive relationship between the eventual winner's chances and the stock market volatility. They attribute this to the fact that the arrival of unanticipated information – in this case the increase in the probabilities of the eventual winner – increase the volatility. However, as politicians usually describe their goals and policies thoroughly before the elections, I believe that it would be logical that the higher the probability of a candidate is, the lower the volatility should be; The markets can be more certain about the features of the policy that will be implemented in the future when there is less uncertainty about the election results – Goodell and Vähämaa (2013) actually concluded the exact opposite.

A possible explanation for Goodell and Vähämaa's (2013) results could be that they did not control for the incumbency of a candidate/party. Markets might consider that there is less uncertainty about the

incumbent candidate's economic policy because there is real evidence about the candidate's actions, not just electoral promises of future actions. Many studies, which have taken this into account (see e.g. Bialkowski et al. 2008; Smales 2014), have ended up in the conclusion that if the party that wins the elections is not an incumbent one, the volatility reactions that relate to the elections are stronger. This is consistent with the notion of Cao et al. (2011) who argue that investors are biased in favor of the status quo. However, also other factors than the probability of policy changes affect how the political uncertainty is reflected to the markets. Smales (2014) provides evidence that the relationship between the variables is strongest when the uncertainty is high, business cycle is contracting and economic risk indicator are high. This is consistent with the findings of Pástor and Veronesi (2013) who document that the political risk premium is higher in weak economic conditions.

As discussed above, electoral uncertainty is proven to transmit to the equity markets. However, there are few studies on its effect on the volatility of foreign exchange rates. Chrétien and Coggins (2009) document that while the standard deviation of the Canadian dollar does seem to react to political uncertainty, the results do not reach statistical significance with control variables. Lobo and Tufte (1998) provide some evidence about the relationship between elections and exchange rates, though: the volatility of JPY, GBP, DEM, and CAD relative to USD was affected by the election season and/or the partisan effect. In addition, the volatilities of GBP, JPY and DEM increases right before US presidential elections. However, Lobo and Tufte (1998) do not consider the candidates' probabilities to get elected and thus base their measures of political uncertainty merely on the partisan effect and the political business cycles. What I am interested in my empirical study is to find out how the popularity of a candidate affects the volatility of currency markets as an indicator of political uncertainty that relates to the elections. As opposed to Goodell and Vähämaa (2013), who have also utilized betting result about US presidential elections in a volatility study, my tests are based on the FX volatility instead of stock market volatility. Importantly, I also control for both the incumbency and the partisan effect. This way, my results can be linked to the earlier studies that have explored the previously mentioned effects without taking into account the evolving public opinion about the candidates' probabilities.

2.3 The hypothesis

In this thesis, I test how the volatility of the return on the trade-weighted US dollar index responds to the level of political uncertainty during the time before the last seven US presidential elections. I utilize probability data drawn from the Iowa Electronic Markets to construct measures of political uncertainty that take into account separately and in a mixed way (I) the probability of the eventual winner, (II) the distance from 50/50 probability position, (III) the partisan effect and (IV) the incumbency effect. With these measures, I test the following three hypotheses:

H_1 : the uncertainty hypothesis
The higher the level of the political uncertainty is, the higher the conditional volatility of USD is.

H_2 : **the partisan hypothesis**
The partisan effect influences the volatility of USD – i.e. the FX markets have a preferred party.

H_3 : the incumbency hypothesis
The higher the probability of victory is for the party that is out-of-power, the higher the conditional volatility of USD is.

As already referred to in this paper, according to the best of my knowledge, there is no earlier study that would link the evolving market consensus about the election outcome to the uncertainty in the FX market. In addition, my research provides new evidence about how the partisan and incumbency effects are reflected to the currency market in form of expectations about the future macroeconomic policy - rather than how the implemented policies are perceived by the market.

3. Description of the data set and the variables

My data set covers 315 observations from the seven US presidential elections during years 1992 – 2016 and includes daily observations (business days) of each variable from the beginning of September of the elections years till the election dates. The reasons why I am interested studying the US markets have to do with the availability of data but also with the impact that the US politics has globally. For instance, relating to the political cycle theory, Tufte (1978) states that US presidential elections have almost the

same impact on economic growth in Canada, France, Germany, Japan and UK as their own national elections. Thus, the political uncertainty in the US might transmit globally straight to economy as well as through the changing foreign exchange rates.

3.1 Iowa Electronic Market betting results

The probability data that I use is drawn from the Iowa Electronic Markets ("IEM") – a prediction market, managed by the University of Iowa, where future contracts regarding e.g. politics, economic indicators and quarterly earnings are traded. My study is based on the average daily prices of US presidential election "winner takes it all" –contracts. The payoff for such a contract is 1 if the candidate who you are betting on wins the election; Otherwise the payoff is zero. Thus, the price of a contract tells the market consensus about the probability of a candidate to become elected. The sum of different candidates' contract prices should equal one – i.e. 100% probability.

Based on the market consensus about the eventual winner, Goodell and Vähämaa (2013) construct a measure of election uncertainty that I am utilizing in my regressions:

$$ElecUn_{n,t} = 1 - |ProbWin_{n,t} - (1 - ProbWin_{n,t})| \quad (1)$$

where $ElecUn_{n,t}$ captures the distance of from a fifty-fifty position during election year n on day t, and $ProbWin_{n,t}$ is the probability of victory for the eventual winner during election year n on day t. The value of ElecUn is always between 0 and 1: when the both the candidates' probabilities are 50%, ElecUn gets the value of 1 indicating high uncertainty about the election result, and when the winner of an election is certain, i.e. ProbWin is 100%, the value of ElecUn is 0 et cetera.

One should keep in mind that the betting odds might influence the elections results, too – not only the other way around - because they are nowadays often discussed in the media throughout election seasons. This creates an incentive for traders and political parties to try to manipulate the odds in favor of their candidate. Berg and Rietz (2014) have addressed this issue in their study concluding that there is little evidence of the IEM being successfully manipulated in long term. They attribute this to the fact that the IEM has a position limit of $500 and that the unit portfolios restrict arbitrage possibilities for naïve

manipulations. Goodell et al. (2015) state that consistent with previous studies, their findings indicate that the IEM - and also prediction markets in general - outperform other forms of probability measurements such as opinion polls. In addition, they provide evidence that different prediction markets are strongly integrated.

3.2 The conditional volatility of the US dollar

I use the Federal Reserve's Trade Weighted US Dollar Major Currencies Index ("USD index") (1973 Mar = 100) from Fed's database to calculate the conditional volatility of the return on the US dollar. The index is trade-weighted and constructed of the daily exchange rates of USD against the Euro (or the currencies replaced by the Euro), the Canadian dollar, the Japanese yen, the Pound sterling, the Swiss Franc, the Australian dollar and the Swedish krona. The daily returns are calculated using logarithms.

To calculate the conditional variance, I use GARCH(1,1) model[3] developed by Bollerslev (1986):

$$r_t = \mu + \varepsilon_t \quad (2)$$

$$z_t = \frac{\varepsilon_t}{\sigma_t} \sim t(\delta) \quad (3)$$

$$\sigma_t^2 = \omega + \beta_1(\varepsilon_{t-1}^2) + \beta_2(\sigma_{t-1|t-2}^2) \quad (4)^4$$

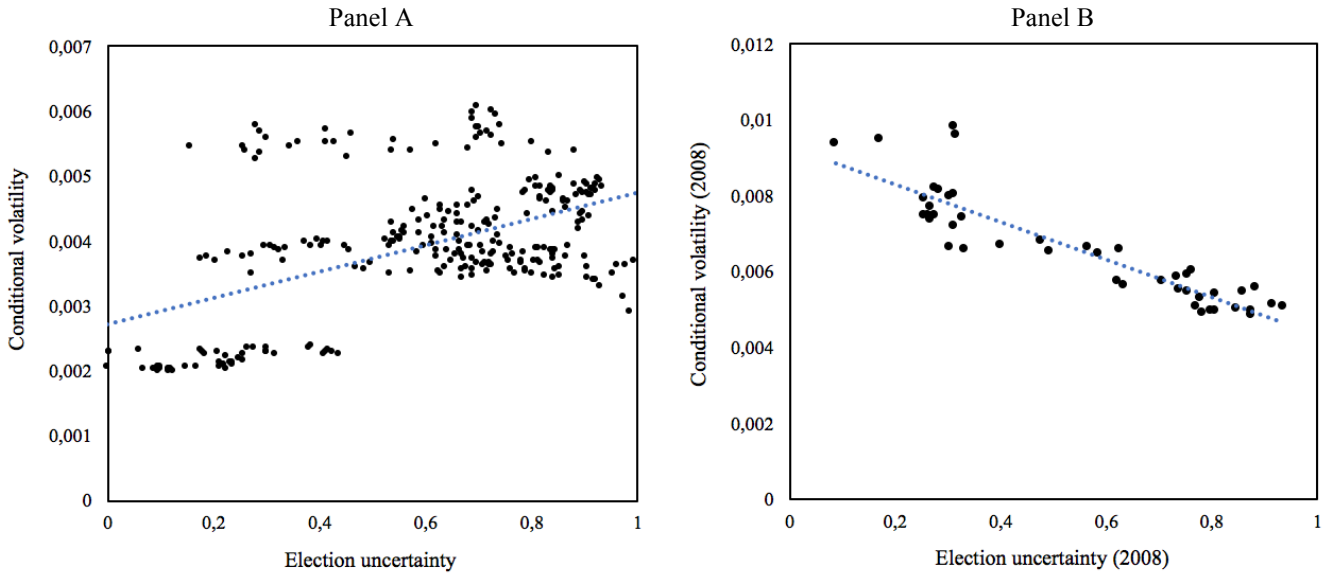
Where Equation (2) defines the return (r_t) as a function of the expected return (μ) and the error term (ε_t) that can be interpreted as the multiplication of the conditional volatility (σ_t) and the Gaussian white noise (z_t). Equation (4) defines the density function. I use t-distribution in stead of the normal distribution because of the fat tales of the sample[5]. Equation (4) defines the conditional variance (σ_t^2) as a function of the weighted long run variance (ω), the ARCH term $\beta_1(\varepsilon_{t-1}^2)$, and the GARCH term $\beta_2(\sigma_{t-1|t-2}^2)$. When defining the parameters in the Equations, I use USD index data that covers a period from the first election year (1992) of the sample till the last one (2016) based on what Lam and Ng (2006) state about the sample size for GARCH models.

[3] the Generalized Autoregressive Conditional Heteroskedasticity model
[4] $\omega, \beta_1, \beta_2 > 0$ constraint set to ensure positive variances
[5] kurtosis = 7.627

Figure 1 models the relationship between the conditional volatility of the US Dollar and ElecUn, a measure of election uncertainty, to present the rough connection between the variables. The election of 2008 is separated to Panel B because of the abnormal market environment caused by the financial crisis in the late 2008. Consistently, I will later present all the results both including and excluding the data from 2008. As can be seen from Panel A, the relationship between the variables is the stronger, the higher the uncertainty is.

Figure 1

Panel A: Conditional volatility of USD and Election uncertainty, all years except 2008
Panel B: Conditional volatility of USD and Election uncertainty, year 2008



3.3 Macroeconomic control variables

To control for the effects that macroeconomic factors have on the conditional FX volatility, I include to my models some macroeconomic indicators of which daily data is available: the federal funds rate ("FFR"), the term spread between 10- and 3-year constant maturity US treasury bonds, and the return on the USD index. The data about the FFR and the term spread is obtained through the Federal Reserve's database. The FFR reflects market liquidity, and as high conditional volatility is likely a response to low levels of liquidity (Goddard et al. 2015), the FFR should account for some of the liquidity's impact on the FX volatility. The term spread, in turn, reflects the economic environment, such as inflation

expectations. A widening spread usually indicates the market players' expectations about stable economic environment as the yield curve becomes more positive - and vice versa. The return on the USD index is included as a control variable because stronger USD implies positive expectations about the economic growth in the US. In addition, I control for the impact of global recessions utilizing an OECD based recession indicator that is obtained through the database of the Federal Reserve bank of St. Louis. The value of the indicator is one during the election seasons in 2000, 2008 and 2012, and otherwise zero.

4. Methodology

I use standard OLS regressions to test the hypothesis defined in Section 3.3. All the different regression models that I use in this paper are based on the below Equation (5) in which I regress the conditional volatility of the Trade Weighted US Dollar Major Currencies Index on the probability of the eventual winner, a measure of election uncertainty, and certain control variables in the spirit of Goodell and Vähämaa (2013):

$$\sigma_{n,t} = \beta_0 + \beta_1 ProbWin_{n,t} + \beta_2 ElecUn_{n,t} + \beta_3 FFR_{n,t} + \beta_4 return_{n,t} + \beta_5 spread_{n,t} + \beta_6 \sigma_{n,t-1} + \sum_{n=1}^{k-1} \lambda_n fe_{n,t} + \varepsilon_{n,t} \quad (5)$$

where $\sigma_{n,t}$ is the daily conditional volatility of the US Dollar index during election year n on day t based on the conditional variance defined in Equation (4), $ProbWin_{n,t}$ is the daily probability of victory for the eventual winning candidate during election year n on day t, $ElecUn_{n,t}$ is a daily measure of election uncertainty as defined in Equation (1), $FFR_{n,t}$ is the daily Federal funds rate during election year n on day t, $return_{n,t}$ is the daily return on the US Dollar index during election year n on day t, and $spread_{n,t}$ is the term spread between 10- and 3-year constant maturity T-bonds during election year n on day t. I have also added a one-period-lagged conditional volatility of US Dollar index to Equation (5) because the volatility of FX rates is considered mean-reverting. $Fe_{n,t}$ term in the Equation (5) indicates election fixed-effects while $\varepsilon_{n,t}$ captures the Gaussian noise in the time series.

Table 1 reports the summary statistics for the data, Table 2 reports the yearly key statistics, and Table 3 provides the correlations between the variables. The mean and the standard deviation of the conditional volatility of USD were the highest during the 2008 presidential election when the currency market was largely affected by the financial crisis. The mean values of ProbWin are over 0.5 in all the elections,

except for 2000 and 2016, indicating that the IEM on average estimated the eventual winner correctly. Although the IEM considered the chances of the eventual winner to be on average under 50% in 2000 and 2016, closer to the election date the odds of the winner rose above the 50% threshold in both the elections. ElecUn got especially low values in the 1996 elections after Clinton's (Dem.) first term, while the election uncertainty was the highest on average in the elections of 2000 and 2004 won by Bush (Rep.). Notably, although ProbWin gets a relatively low mean value in the 2016 election, also ElecUn gets a low value indicating that even though the IEM traders did not guess the eventual winner correctly for most of the time, they were quite certain about their incorrect guess that Trump (Rep.) would lose.

The standard deviations of all the variables are the largest during the 2008 election indicating high levels of market anxiety caused mostly by the financial crisis. For instance, the FFR had a relatively large standard deviation in 2008 because the abnormal market environment made the Federal Open Market Committee push the FFR down fast during the last few months before the presidential election took place.

Interestingly, the mean return on the USD index was negative only before the 2000 election meaning that before other elections, the US dollar on average appreciated slightly or remained approximately at the same level. This is consistent with the political business cycle theory (Nordhaus 1975; Hibbs 1977) as according to it, the economic growth is faster during election seasons.

The term spread between 10- and 3-year constant maturity T-bonds was positive except for the election of 2000 when the yield on a 3-year T-bond was higher than the yield on a 10-year T-bond. This is an indication of the exceptional market environment in 2000 as usually the risk premium was higher for bonds that had a longer maturity.

Both ProbWin and Elecun are positively correlated with the volatility. This is possible because ElecUn responds differently to the changes when the value of Probwin is above and under 0.5: If ProbWin is larger (smaller) than 0.5, the value of ElecUn increases (decreases) when Probwin decreases. The FFR is the only one of the macroeconomic variables that is negatively associated with the conditional volatility of USD.

Table 1

Summary statistics: All years.

	Mean	Std. Dev.	Skewness	Min	Max	Median
Volatility	0.004	0.001	0.871	0.002	0.010	0.004
ProbWin	0.616	0.206	-0.401	0.088	0.999	0.630
ElecUn	0.599	0.250	-0.487	0.000	0.996	0.670
FFR	0.027	0.023	0.532	0.001	0.067	0.018
Return	0.000	0.005	-0.412	-0.030	0.018	0.000
Spread	0.010	0.007	-0.289	-0.003	0.023	0.012

This table presents the summary statistics for the variables. The sample consists of a total of 315 daily (business days) observations of the variables between the beginning of September and the election date (in November) in the presidential election years 1992, 1996, 2000, 2004, 2008, 2012 and 2016. *Volatility* is the conditional volatility of return on the Trade Weighted US Dollar index, *ProbWin* is the probability of victory of the eventual winning candidate, *ElecUn* is a measure of election uncertainty, *FFR* is the Federal funds rate, *Return* is the return on the USD index, and *Spread* is the term spread between 10- and 3-year constant maturity T-bonds.

Table 2

Summary statistics: Yearly.

	1992		1996		2000		2004		2008		2012		2016	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Volatility	0.005	0.000	0.002	0.000	0.004	0.000	0.005	0.000	0.007	0.001	0.004	0.000	0.004	0.000
ProbWin	0.695	0.113	0.889	0.055	0.478	0.110	0.583	0.051	0.726	0.127	0.694	0.064	0.279	0.103
ElecUn	0.611	0.227	0.226	0.111	0.808	0.114	0.829	0.091	0.548	0.254	0.613	0.129	0.550	0.189
FFR	0.032	0.003	0.053	0.002	0.065	0.001	0.017	0.001	0.014	0.007	0.002	0.000	0.004	0.000
Return	0.002	0.006	0.000	0.002	0.001	0.004	-0.001	0.004	0.002	0.009	0.000	0.004	0.000	0.004
Spread	0.020	0.001	0.004	0.000	-0.002	0.001	0.013	0.001	0.017	0.003	0.014	0.001	0.008	0.001

This table presents the yearly summary statistics for the variables. The sample consists of a total of 315 daily (business days) observations of the variables between the beginning of September and the election date (in November) in the presidential election years 1992, 1996, 2000, 2004, 2008, 2012 and 2016. *Volatility* is the conditional volatility of return on the Trade Weighted US Dollar index, *ProbWin* is the probability of victory for the eventual winning candidate, *ElecUn*[6] is a measure of election uncertainty, *FFR* is the Federal funds rate, *Return* is the return on the USD index, and *Spread* is the term spread between 10- and 3-year constant maturity T-bonds.

[6]Note: The mean values of *ElecUn* cannot be directly calculated from the mean values of *ProbWin* in 2000, 2004 and 2016 because during those elections the probabilities have varied both above and under 50%, and *ElecUn* responds differently to changes on different sides of the 50% threshold.

Table 3

Correlations.

	Volatility	*ProbWin*	*ElecUn*	*FFR*	*Spread*
ProbWin	0,041				
ElecUn	0,122	-0,500			
FFR	-0,438	0,193	-0,021		
Spread	0,719	0,299	-0,047	-0,632	
Return	0,052	0,006	-0,042	0,025	0,053

This table presents the Pearson correlation coefficients between the variables. *Volatility* is the conditional volatility of Trade Weighted US Dollar Index, *ProbWin* is the probability of victory for the eventual winning candidate, *ElecUn* is a measure of election uncertainty, *FFR* is the Federal funds rate, *Spread* is the term spread between 10- and 3-year constant maturity Treasury bonds*, and Return* is the log-return on the USD index.

5. Results

5.1 Election uncertainty and the conditional volatility

In this Section 5.1, I will be presenting a model of the Equation (5) first excluding the macroeconomic variables to demonstrate the nature of the basic relationship between measures of political uncertainty and the conditional volatility of the US dollar. After that in Section 5.2, I will report the results excluding year 2008 for reasons specified in that section. In Section 5.3, I will include the macroeconomic variables to all the models in order to prove that the relationship between election uncertainty and FX volatility is not driven by the economic environment but rather the political risks.

To test the first hypothesis (H_1: the uncertainty hypothesis), I present a naïve unconditioned version of Equation (5) that includes only three explanatory variables – ProbWin, ElecUn and a one-period-lagged conditional volatility – and election fixed effects. The results of this regression are reported in Table 4 as Model 1. As expected, the estimate for the lagged volatility is large and statistically highly significant. It is also driving the high explanatory rate of the model proving that the volatility of the US Dollar is mean reverting. Same applies to all the models that I will introduce later in this paper. In Model 1, neither ProbWin nor ElecUn is statistically significant. Thus, Model 1 fails to prove that election uncertainty would affect the conditional volatility of the USD.

As a next step, I add an interaction term of ProbWin and Republican dummy to the regression (Model 2, Table 4) to test the second hypothesis (H_2: the partisan hypothesis). The estimate for ProbWin remains

positive and becomes statistically significant at the 10% level while the estimate for the interaction term is negative but does not yet reach statistical significance (P-value 0.129). Thus, Model 2, which does not control for the influence of macroeconomic factors on the conditional volatility, is not able to prove that partisanship would affect the volatility of the USD. However, because the controlling for the partisanship made the sole Probwin variable statistically significant, the FX markets must be some sort of tendency to be more anxious when it becomes more likely that the future president is not a Republican.

Table 4

Regression results: the effect of election uncertainty on conditional volatility

Variable	Model 1	Model 2	Model 3	Model 4
Constant	0.084	-0.212	-0.418	-0.173
	(0.148)	(0.244)	(0.261)	(0.247)
ProbWin	0.134	0.528*	0.528*	0.225
	(0.122)	(0.286)	(0.286)	(0.393)
ElecUn	0.009	0.142	0.142	0.107
	(0.070)	(0.112)	(0.112)	(0.116)
σ_{t-1}	970.5***	959.3***	959.3***	949.2***
	(19.81)	(21.08)	(21.08)	(22.91)
*ProbWin*Republican*		-0.569	-0.569	-0.571
		(0.374)	(0.374)	(0.374)
NewWinner			0.207**	
			(0.097)	
*ProbWin*NewWinner*				0.355
				(0.316)
Fixed or random effects	Fixed	Fixed	Fixed	Fixed
Adj. R^2	0.986	0.986	0.986	0.986
F-Stat	2518***	2277***	2277***	2072***
No. of obs.	315	315	315	315

The table presents the results of different versions of the below regression:

$$\sigma_{n,t} = \beta_0 + \beta_1 ProbWin_{n,t} + \beta_2 ElecUn_{n,t} + \beta_3 \sigma_{n,t-1} + \beta_4 Probwin_{n,t} \cdot Republican_{n,t} + \beta_5 NewWinner_{n,t} + \beta_6 Probwin_{n,t} \cdot Newwinner_{n,t} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t}$$

where $\sigma_{n,t}$ is the daily conditional volatility of the USD Index during election year n on day t, $ProbWin_{n,t}$ is the daily probability of victory for the eventual winning candidate during election year n on day t, $ElecUn_{n,t}$ is a daily measure of election uncertainty during election year n on day t, $\sigma_{n,t-1}$ is the one-period-lagged conditional volatility of the USD Index, $Republican_{n,t}$ is a dummy indicating the political party (Republican = 1), and $NewWinner_{n,t}$ is a dummy indicating changing political control (non-incumbent winner = 1). The estimates are controlled for election fixed effects. Standard errors are reported in parentheses. Values multiplied by 1,000.

*** Significance at the 1% levels.

** Significance at the 5% levels.

* Significance at the 10% levels.

Relating to the third hypothesis (H_3: the incumbency hypothesis), I include a NewWinner dummy to Model 2 to separate the elections in which the incumbent president cannot be re-elected. In the same elections, the control of the White House also happens to switch between the political parties. The results are reported in Table 4 as Model 3, and they do not differ much from the Model 2 except for the fact that NewWinner is positive and statistically significant at the 5% level (P-value 0.034). Thus, the volatility of the US Dollar tends to be higher during those elections when the control shifts between the political parties. This is consistent with the previous studies (Bialkowski et al. 2008; Smales 2014) that have provided evidence that the volatility reaction that relates to the elections is higher when an incumbent party does not get re-elected.

To see if the higher probability of victory for a new candidate also generates a higher FX volatility, I introduce an interaction term of ProbWin and NewWinner to Model 2. The results of this regression are reported in Table 4 as Model 4. The interaction term is not statistically significant which means that Model 4 does not provide evidence that the markets would react differently to changing probabilities in those elections where the control shifts between the parties in comparison with other elections.

5.2 Election uncertainty and the conditional volatility excluding 2008

The financial crisis in 2008 is widely known to have caused severe market disturbances at the same time as the US presidential election of 2008 was approaching. As the effect of the crisis is difficult to fully isolate from the results using macroeconomic variables that are available on daily bases, in this section I will first show how remarkably the relationship between the variables differs in 2008 compared to the other elections. After that, I will present the results of the previous regressions excluding the 2008 election data.

Table 5 reports the results of two regressions that include ProbWin, ElecUn, a one-period lagged conditional volatility, and interaction terms between ProbWin and election year dummies as explanatory variables to show how the relationship between the election probabilities and the volatility of the USD index differs between the elections. Model 2 includes also the FFR, the return on the USD index and the term spread as macroeconomic variables. As can be seen from the results, the interaction term of 2008 is exceptional in many ways: it is the only interaction term that has a positive value, and when the

macroeconomic variables are not included to the model, its absolute value is the largest and it is also statistically highly significant at the 1% level (P-value 0.001 in Model 1). Thus, the data from 2008 must influence the general results remarkably. As the volatility is exceptionally strongly driven by other factors than the election uncertainty during the 2008 election season, and for instance the bankruptcy of Lehman Brothers took place during the season, it makes sense to demonstrate how the results are excluding year 2008.

Table 6 reports the results of the same regression models as Table 4 but the data from 2008 election is excluded. Interestingly, in Models 2 – 4, the estimates for ElecUn are positive and statistically significant at the 5% level meaning that when there is more uncertainty about the eventual winner, the volatility of the US Dollar is higher. I.e. the election uncertainty transmits to the foreign exchange which supports to my first hypothesis (H_1: the uncertainty hypothesis).

The results regarding the second hypothesis (H_2: the partisan hypothesis) differ from the previous results in the sense that the interaction term between ProbWin and Republican dummy is now statistically significant at the 10% level in all the models. Although the estimates do not reach the traditional 95% confidence level, they suggest that there is a clear possibility that the FX market volatility tends to decrease when the changes of a Republican candidate increase – but not when a ”random” candidate’s chances increase. This would mean that the FX markets favor Republican presidents (although only at the 90% confidence level), and that the partisan effect would influence the volatility of the US Dollar - which would be in line with the previous studies that have recorded a presence of the partisan effect in the financial markets (see e.g. Hibbs 1986, Snowberg et al. 2007, Alvarez-Ramirez et al. 2012, Dettrey and Palmer 2015). In addition, although Goodell and Vähämaa (2013) did not find evidence of the partisan effect in the US stock market, they showed that the volatility of S&P500 index tends to increase when the chances of the eventual winner increase. This would partially support the fact that the estimate for the sole Probwin variable is positive in Model 2. Another possible explanation for the positive estimate of Probwin in the light of the partisan theory would be that the FX market in general might dislike Democratic candidates which would increase the volatility when the election of a Democrat becomes more likely.

Table 5

Regression results: yearly effects of winning probabilities on conditional volatility

	Model 1		Model 2	
Variable	Estimate	Standard error	Estimate	Standard error
Constant	0.119	0.431	0.097	0.574
ProbWin	0.528	0.445	0.661	0.452
ElecUn	0.225	0.191	0.263	0.191
σ_{t-1}	887.9***	28.98	860.0***	30.36
*ProbWin*2016*	-0.750	0.789	-0.979	0.797
*ProbWin*2012*	-0.109	0.447	-0.146	0.444
*ProbWin*2008*	1.241***	0.368	0.734	0.524
*ProbWin*2004*	-0.502	0.555	-0.502	0.552
*ProbWin*2000*	-0.560	0.485	-0.745	0.499
*ProbWin*1996*	-0.300	0.507	-0.476	0.511
FFR			-7.985**	3.879
Return			-3.227*	1.858
Spread			16.20	14.89
Fixed or random effects	Fixed		Fixed	
Adj. R^2	0.987		0.987	
F-Stat	1562***		1328***	
No. of obs.	315		315	

The table presents the results of two different versions of the below regression:

$$\sigma_{n,t} = \beta_0 + \beta_1 ProbWin_{n,t} + \beta_2 ElecUn_{n,t} + \beta_3 \sigma_{n,t-1} + \sum_{n=1}^{k-1} \lambda_n \cdot Probwin_{n,t} + \beta_4 FFR_{n,t} + \beta_5 return_{n,t} + \beta_6 spread_{n,t} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t}$$

where $\sigma_{n,t}$ is the daily conditional volatility of USD Index during election year n on day t, $ProbWin_{n,t}$ is the daily probability of victory for the eventually winning candidate during election year n on day t, $ElecUn_{n,t}$ is a daily measure of election uncertainty during election year n on day t, $\sigma_{n,t-1}$ is the one-period-lagged conditional volatility of the USD Index, and the first sum term defines the interaction terms between the conditional volatility of the USD Index and the election-specific dummies λ_n (n = 2016, 2012, 2008, 2004, 2000 and 1996). In Model 2, $FFR_{n,t}$ is the daily Federal funds rate, $return_{n,t}$ is the daily return on the USD Index, and $spread_{n,t}$ is the daily term spread between 10- and 3-year constant maturity T-bonds. The estimates are controlled for election fixed effects. Values multiplied by 1,000.

*** Significance at the 1% levels.

** Significance at the 5% levels.

* Significance at the 10% levels.

Table 6

Regression results: election uncertainty and conditional volatility excluding 2008

Variable	Model 1	Model 2	Model 3	Model 4
Constant	0.519***	0.301	-0.103	0.312
	(0.146)	(0.192)	(0.179)	(0.192)
ProbWin	0.050	0.352*	0.352*	0.229
	(0.081)	(0.191)	(0.191)	(0.256)
ElecUn	0.072	0.170**	0.170**	0.154**
	(0.047)	(0.073)	(0.073)	(0.076)
σ_{t-1}	892.8***	883.1***	883.1***	878.7***
	(23.86)	(24.42)	(24.42)	(25.17)
*ProbWin*Republican*		-0.430*	-0.430*	-0.440*
		(0.247)	(0.247)	(0.248)
NewWinner			0.404***	
			(0.089)	
*ProbWin*NewWinner*				0.155
				(0.213)
Fixed or random effects	Fixed	Fixed	Fixed	Fixed
Adj. R^2	0.989	0.989	0.989	0.989
F-Stat	2952***	2644***	2644***	2376***
No. of obs.	270	270	270	270

The table presents the results of different versions of the below regression:

$$\sigma_{n,t} = \beta_0 + \beta_1 ProbWin_{n,t} + \beta_2 ElecUn_{n,t} + \beta_3 \sigma_{n,t-1} + \beta_4 Probwin_{n,t} \cdot Republican_{n,t} + \beta_5 NewWinner_{n,t} + \beta_6 Probwin_{n,t} \cdot Newwinner_{n,t} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t}$$

where $\sigma_{n,t}$ is the daily conditional volatility of USD Index during election year n on day t, and $ProbWin_{n,t}$ is the probability of victory for the eventually winning candidate during election year n on day t, $ElecUn_{n,t}$ is a measure of election uncertainty during election year n on day t, $\sigma_{n,t-1}$ is the one-period-lagged conditional volatility of USD Index, $Republican_{n,t}$ is a dummy indicating the political party (Republican=1), and $NewWinner_{n,t}$ is a dummy indicating a changing political control (non-incumbent winner = 1). The estimates are controlled for election fixed effects. Standard errors are reported in parentheses. Values multiplied by 1,000.

*** Significance at the 1% levels.

** Significance at the 5% levels.

* Significance at the 10% levels.

Another intriguing aspect about the new results is that NewWinner dummy in Model 3 reaches now an even higher value and confidence level (P-value 7.98e-06) while the interaction term between ProbWin and NewWinner in Model 4 remains statistically insignificant. This means that the incumbency hypothesis (H_3) cannot be proven correct by the models: higher probabilities of a new president do not

seem to create anxiety to market in a statistically significant manner. However, the conditional volatility of the US Dollar is higher during elections when there is no incumbent candidate running for the presidency. Thus, the market anxiety does not appear to be attributed to the increasing probability of changing control between the parties but rather the fact that there will be an inevitable change in the economic policy as the president changes when the incumbent president is not running for the office.

5.3 Macroeconomic factors, election uncertainty and conditional volatility

To demonstrate how the macroeconomic environment affects the the results reported in Sections 5.1 and 5.2, I am now introducing some macroeconomic variables to the regressions. As discussed in Sections 2.1 – 2.3, economic conditions do not only influence the conditional volatility but also the nature of the relationship between political uncertainty and the volatility of financial assets (see e.g. Pástor and Veronesi 2013; Smales 2014). That is why I also include an interaction term between ProbWin and an OECD-based recession indicator to the models. This way, the the impact that recessions have on the relationship between the betting odds and the FX volatility can be controlled for.

The results are reported in Table 7. The estimates for ElecUn are positive and significant at the 10 % level (Models 2 – 3, all year) or at the 5% level (Models 2 – 4, excluding the 2008 data) suggesting that the level of political uncertainty transmits to the FX market in form of anxiety when the macroeconomic factors are taken into account. This finding further supports the uncertainty hypothesis (H_1).

In all the models, the estimates for ProbWin are now statistically insignificant. At the same time, the interaction terms between ProbWin and Republican dummy are negative and reach the 90% confidence level when all years are studied simultaneously. This finding implies the partisan effect is likely to be present in the foreign exchange as the increasing probability for a Republican candidate seems to be attributed to a lower volatility. This supports the partisan hypothesis (H_2) although the election of 2008 seems to be central for the evidence: the statistical significance of the interaction term falls just below the 10% threshold when 2008 is excluded (P-values between 0.108 and 0.121). However, the macroeconomic variables that make the interaction term insignificant, are not statistically significant either when 2008 is excluded, and thus one can also question how valid their effect on the term is.

Another interesting change in the results caused by the macroeconomic variables is the fact that NewWinner dummy becomes statistically insignificant in Model 3 when the 2008 election is included to the data. However, when the 2008 election is excluded, NewWinner dummy is again positive and statistically significant at the 1% level (P-value 0.006). This might be due to the fact that, as demonstrated in Section 5.2, it is difficult to correctly isolate the effect that the financial crisis has on the conditional FX volatility. In any case, the macroeconomic variables do not change the fact that the incumbency hypothesis (H_3) is not supported by the analyses as the interaction term between ProbWin and NewWinner remains statistically insignificant: the higher probabilities of a new president do not seem to create market anxiety in a remarkable way.

In the regression models that include all the election years, the term spread between 10- and 3-year constant maturity T-bonds is by far the most remarkable macroeconomic variable: its absolute value is the largest and it is significant at the 5% level when all election years are included. However, the relatively large positive impact of the term spread on the conditional FX volatility appears to be largely attributed to the 2008 election. When the 2008 data is excluded, the term spread loses its statistical significance and becomes negative. I.e. the term spread gets a relatively large positive value in All years -models because in 2008 the term spread was large due to the financial market disturbances, and at the same time the FX volatility was naturally high. A similar trend dominates also the FFR estimates: when 2008 is exclude, the FFR loses it statistical significance. When all years are included, the estimates of FFR are negative and statistically significant at the 5% level as in 2008 the FFR dropped very fast during the end of the election season and thus its rage during the election period was exceptionally wide.

The estimates for the return on the USD index are negative but statistically insignificant in all the models. The relationship between the odds and the conditional volatility does not seem to be affected much by the recession indicator which is contrary to Smales' (2014) study that is based on the Australian equity and bond markets. Notable about the results is also that judged by the statistical significance, the measures of political uncertainty have a clearer impact on the conditional FX volatility than the macroeconomic variables when the 2008 election is excluded – although the econometric significance of the macroeconomic variables is larger even then.

Table 7

Regression results: the effect of macroeconomic variables to the relationship between election uncertainty and conditional volatility

	Result: All years				Results: excluding 2008			
Variable	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	0.278	-0.011	0.151	0.017	0.885***	0.634*	0.073	0.634*
	(0.307)	(0.350)	(0.356)	(0.352)	(0.293)	(0.334)	(0.300)	(0.334)
ProbWin	0.060	0.462	0.462	0.266	0.061	0.321	0.321	0.195
	(0.151)	(0.281)	(0.281)	(0.385)	(0.102)	(0.195)	(0.195)	(0.258)
ElecUn	0.035	0.195*	0.195*	0.171	0.078	0.176**	0.176**	0.162**
	(0.069)	(0.117)	(0.117)	(0.121)	(0.047)	(0.079)	(0.079)	(0.081)
σ_{t-1}	893.7***	881.9***	881.9***	876.9***	891.7***	885.0***	885.0***	880.4***
	(27.02)	(27.82)	(27.82)	(28.63)	(24.48)	(24.79)	(24.79)	(25.55)
*ProbWin*Republican*		-0.666*	-0.666*	-0.670*		-0.431	-0.431	-0.448
		(0.392)	(0.392)	(0.393)		(0.277)	(0.277)	(0.278)
NewWinner			-0.162				0.561***	
			(0.161)				(0.202)	
*ProbWin*NewWinner*				0.233				0.161
				(0.312)				(0.215)
*ProbWin*Recession*	0.027	0.177	0.177	0.178	-0.049	0.065	0.065	0.072
	(0.235)	(0.251)	(0.251)	(0.251)	(0.165)	(0.180)	(0.180)	(0.181)
FFR	-9.476**	-8.871**	-8.871**	-8.728**	-2.466	-1.788	-1.788	-1.479
	(3.833)	(3.838)	(3.838)	(3.845)	(3.912)	(3.925)	(3.925)	(3.950)
Return	-2.377	-2.697	-2.697	-2.803	-1.179	-1.361	-1.361	-1.430
	(1.832)	(1.836)	(1.836)	(1.843)	(1.712)	(1.711)	(1.711)	(1.715)
Spread	28.49**	26.21**	26.21**	25.36**	-14.75	-13.47	-1.347	-13.53
	(11.66)	(11.70)	(11.70)	(11.77)	(11.18)	(11.18)	(11.18)	(11.19)
Fixed or random effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Adj. R^2	0.987	0.987	0.987	0.987	0.989	0.989	0.989	0.989
F-Stat	1828***	1708***	1708***	1592***	1959***	1818***	1818***	1686***
No. of obs.	315	315	315	315	270	270	270	270

The table reports different versions of the below regression both including and excluding the election of 2008:

$$\sigma_{n,t} = \beta_0 + \beta_1 ProbWin_{n,t} + \beta_2 ElecUn_{n,t} + \beta_3 \sigma_{n,t-1} + \beta_4 Probwin_{n,t} \cdot Republican_{n,t} + \beta_5 NewWinner_{n,t} + \beta_6 Probwin_{n,t} \cdot Newwinner_{n,t} + \beta_7 ProbWin_{n,t} * Recession_{n,t} + \beta_8 FFR_{n,t} + \beta_9 return_{n,t} + \beta_{10} spread_{n,t} + \sum_{n=1}^{k-1} \lambda_n \text{fe}_{n,t} + \varepsilon_{n,t}$$

where $\sigma_{n,t}$ is the daily conditional volatility of USD Index during election year n on day t, $ProbWin_{n,t}$ is the daily probability of victory for the eventually winning candidate during election year n on day t, $ElecUn_{n,t}$ is a daily measure of election uncertainty during election year n on day t, $\sigma_{n,t-1}$ is the one-period-lagged conditional volatility of USD Index, $Republican_{n,t}$ is a dummy indicating the political party (Republican = 1), $NewWinner_{n,t}$ is a dummy indicating a changing political control (non-incumbent winner = 1), Recession is a dummy indicating a recession (recession = 1), $FFR_{n,t}$ is the Federal funds rate during election year n on day t, $return_{n,t}$ is the return on the USD Index during election year n on day t, and $spread_{n,t}$ is the term spread between 10- and 3-year constant maturity T-bonds during election year n on day t. The estimates controlled for election fixed effects. Standard errors reported in parentheses. Values multiplied by 1,000. *** Significance at the 1% levels. ** Significance at the 5% levels. * Significance at the 10% levels.

As discussed earlier in Section 2.1, it is possible that the macroeconomic environment affects voting behavior. That is why I perform a robustness check in spirit of Goodell and Vähämaa (2013) and Smales (2014) to see whether the key variables, ProbWin and ElecUn, are driven by the macroeconomic factors. First, I regress ProbWin and ElecUn on the lagged measures of the FFR, the return on the USD index, the term spread between 10- and 3-year T-bonds, and a recession indicator:

$$ProbWin_{n,t} = \beta_0 + \beta_1 FFR_{n,t-1} + \beta_2 return_{n,t-1} + \beta_3 spread_{n,t-1} + \beta_4 recession_{n,t-1} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t} \quad (6)$$

$$ElecUn_{n,t} = \beta_0 + \beta_1 FFR_{n,t-1} + \beta_2 return_{n,t-1} + \beta_3 spread_{n,t-1} + \beta_4 recession_{n,t-1} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t} \quad (7)$$

The residuals of the Equations (6 and 7) account for the part of ProbWin and ElecUn variables that are not influenced by the macroeconomic variables. Thus, with these residuals I can study the effect that election uncertainty has on the conditional FX volatility excluding the influence that the macroeconomic factors have on voting behavior. I define PW_Resid as the residual in Equation (6) and EU_Resid as the residual in Equation (7). Table 8 reports the results of the new regressions in which PW_Resid and EU_Resid replace ProbWin and ElecUn, respectively.

ElecUn is still positive and gets statistically very highly significant estimates at the 1% (and 5%) levels when the 2008 election is excluded. Thus, the relationship between election uncertainty and the conditional volatility of the US Dollar does not seem to be attributed to the influence of macroeconomic factors. The interaction terms between ProbWin and Republican dummy are statistically significant at the 5% level when the 2008 election is excluded indicating that the increasing probabilities of victory for Republican candidates have a tendency to decrease the volatility of the USD. However, interestingly the significance at the traditional confidence levels disappears when all years are studied simultaneously. This might again be explained by the effects of financial crisis. The estimates for NewWinner in Table 8 do not largely differ form the estimates reported in Table 7: the estimate for the dummy is positive and statistically significant at the 1% level when the 2008 election is excluded.

Table 8

Robustness check: orthogonalized election uncertainty and conditional volatility

	Result: All years				Results: excluding 2008			
Variable	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	0.343	0.343	0.535	0.385	1.004***	0.915***	0.283	0.962***
	(0.265)	(0.265)	(0.249)	(0.270)	(0.283)	(0.283)	(0.232)	(0.285)
ProbWin	0.065	0.251	0.251	0.037	0.092	0.430**	0.430**	0.207
	(0.150)	(0.268)	(0.268)	(0.374)	(0.102)	(0.183)	(0.183)	(0.249)
ElecUn	0.027	0.100	0.100*	0.074	0.108**	0.238***	0.238***	0.212***
	(0.067)	(0.111)	(0.111)	(0.115)	(0.047)	(0.075)	(0.075)	(0.077)
σ_{t-1}	892.4***	888.8***	888.8***	883.4***	891.3***	885.2***	885.2***	876.5***
	(27.12)	(27.47)	(27.47)	(28.25)	(24.10)	(24.08)	(24.07)	(24.92)
*ProbWin*Republican*		-0.309	-0.309	-0.318		-0.567**	-0.567**	-0.590**
		(0.369)	(0.369)	(0.369)		(0.257)	(0.257)	(0.257)
NewWinner			-0.193				0.634***	
			(0.157)				(0.203)	
*ProbWin*NewWinner*				0.255				0.277
				(0.310)				(0.209)
*ProbWin*Recession*	0.041	0.135	0.135	0.132	0.033	0.207	0.207	0.211
	(0.212)	(0.240)	(0.240)	(0.249)	(0.144)	(0.163)	(0.163)	(0.163)
FFR	-7.683**	-8.997**	-8.997**	-8.875**	-2.409	-0.969	-0.969	-0.391
	(3.825)	(3.868)	(3.868)	(3.875)	(3.889)	(3.915)	(3.925)	(3.933)
Return	-2.470	-2.616	-2.616	-2.761	-1.236	-1.409	-1.409	-1.633
	(1.834)	(1.843)	(1.843)	(1.852)	(1.701)	(1.690)	(1.690)	(1.696)
Spread	28.70**	26.16**	28.96**	28.21**	-16.15	-12.27	-12.27	-13.22
	(11.23)	(11.24)	(11.24)	(11.28)	(11.26)	(11.31)	(11.31)	(11.32)
Fixed or random effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
Adj. R^2	0.987	0.987	0.987	0.987	0.989	0.989	0.989	0.989
F-Stat	1829***	1697***	1697***	1582***	1985***	1860***	1860***	1733***
No. of obs.	315	315	315	315	270	270	270	270

The table reports different versions of the below regression both including and excluding the election of 2008:

$$\sigma_{n,t} = \beta_0 + \beta_1 PW_{Resid_{n,t}} + \beta_2 EU_{Resid_{n,t}} + \beta_3 \sigma_{n,t-1} + \beta_4 PW_{Resid_{n,t}} \cdot Republican_{n,t} + \beta_5 NewWinner_{n,t}$$
$$+ \beta_6 PW\_Resid_{n,t} \cdot Newwinner_{n,t} + \beta_7 PW\_Resid_{n,t} * Recession_{n,t} + \beta_8 FFR_{n,t} + \beta_9 return_{n,t} + \beta_{10} spread_{n,t} + \sum_{n=1}^{k-1} \lambda_n \mathrm{fe}_{n,t} + \varepsilon_{n,t}$$

where $\sigma_{n,t}$ is the daily conditional volatility of USD Index during election year n on day t, $PW\_Resid_{n,t}$ is the residual in Equation (6) during election year n on day t, $EU\_Resid_{n,t}$ is the residual in Equation (7) during election year n on day t, $\sigma_{n,t-1}$ is the one-period-lagged conditional volatility of USD Index, $Republican_{n,t}$ is a dummy indicating the political party (Republican = 1), $NewWinner_{n,t}$ is a dummy indicating a changing political control (non-incumbent winner = 1), Recession is a dummy indicating a recession (recession = 1), $FFR_{n,t}$ is the Federal funds rate during election year n on day t, $return_{n,t}$ is the return on the USD Index during election year n on day t, and $spread_{n,t}$ is the term spread between 10- and 3-year constant maturity T-Bonds during election year n on day t. The estimates controlled for election fixed effects. Standard errors reported in parentheses. Values multiplied by 1,000.

*** Significance at the 1% levels. ** Significance at the 5% levels. * Significance at the 10% levels.

Consistent with the results reported in Table 7, FFR still has a negative impact on the conditional FX volatility at the 95% confidence level when all elections are included to the data. The term spread remains as the most dominant macroeconomic variable by absolute value and it is still statistically significant at the 5% level in All years -models. Overall, when the exceptional data of 2008 is excluded and the effects that economic conditions have on the voting behavior are controlled for, the connections between measures of political uncertainty and the conditional volatility appear especially clear. This suggests that political uncertainty transmits to the foreign exchange – and in different ways depending on the partisanship and incumbency of a candidate.

6. Discussion

In general, the findings of this thesis provide brand new evidence on the impact that political uncertainty has on the volatility of the foreign exchange rates during an election season, and how different kinds of election characteristics affect this relationship. I document that the more uncertainty there is about the future president, the more anxious the FX markets are: The estimates of the variable that measures the distance from 50/50 position get positive and statistically significant values in most of the models. The significance of the findings is especially high when the election of 2008 is excluded from the sample. Overall, my empirical results regarding the transmission of election uncertainty are consistent with the uncertainty hypothesis and the earlier findings (see e.g. Bialkowski et al. 2008, Pástor and Veronesi 2013, and Smales 2014) that have been able to link measures of increasing political uncertainty to increasing volatility in the stock market.

In simple models that do not distinguish Republican and Democratic candidates, the estimates for the probability of the eventual winner do not reach statistical significance. However, when the results are controlled for partisan effect and the impact of the financial crisis (by excluding 2008 and/or controlling with macroeconomic variables), my findings suggests that the higher the changes of a Republican candidate are, the lower the volatility of USD is. This is consistent with the partisan theory (Hibbs 1977, 1986) and various earlier studies that have provided evidence of the presence of the partisan effect in financial markets (see e.g. Snowberg et al. 2007; Alvarez-Ramirez et al. 2012; Smales 2014; Dettrey and Palmer 2015). There are also studies that provide opposite results, though. For instance, Goodell and

Vähämaa (2013) do not find evidence on the partisan effect when they study the relationship between presidential election betting odds and the implied volatility of S&P500.

In the elections in which the control shifts between the political parties – which also happen to be the same elections in which there is no incumbent candidate running for the presidency – the volatility tends to be higher according to most of the models: A dummy that indicates those years gets a positive and statistically highly significant value, except for the model in which the 2008 election and the macroeconomic variables are included simultaneously. This finding suggests that the market reactions are stronger when the control shifts between the parties and/or the change of the president is unavoidable. This is natural since there is more uncertainty about the about the future macroeconomic policy when the status quo breaks and the president changes - and as Cao et al. (2011) argue, investors are biased in favor of the status quo. In addition, as Snowberg et al. (2007) point out, some elections transmit more news than others – which could also explain the higher volatility in the elections where the president changes because with the president, also the macroeconomic policy might change. The higher levels of volatility that I have documented seem to be attributed precisely to the fact that the status quo breaks inevitably because the higher probabilities of a victory for a non-incumbent winner do not further increase the volatility at least in a statistically significant manner.

7. Conclusions

In this thesis, I have studied the effects that political uncertainty has on the conditional volatility of the US Dollar during the homestretches of the last seven US presidential election seasons. When thinking about the political uncertainty, my main focus has been on the evolvement of public opinion regarding the election outcome and how different factors, such as the incumbency or partisanship of a candidate, affect the market reaction that the uncertainty generates. My empirical results are largely robust to controlling for macroeconomic variables, and they provide evidence on the previously unexplored relationship between the FX volatility and the market consensus about the eventual winner. The main findings of my thesis can be summarized as follows:

First, especially after excluding the elections of 2008 from the data due to the abnormal market environment caused by the peak of the financial crisis, my findings suggest that there is a positive relationship between election uncertainty and the conditional volatility of the US Dollar. The notion that

political uncertainty is associated with higher FX volatility is consistent with the earlier literature (see e.g. Bialkowski et al. 2008; Pástor and Veronesi 2013; Smales 2014) that has studied the volatilities of other financial assets.

Secondly, after controlling for the macroeconomic environment, my findings suggest that the increasing market consensus about the eventual winner does not affect the volatility of the US Dollar in a statistically significant manner – unless the winner will be a Republican. I document that when the effect of the financial crisis is controlled for, higher probabilities for a Republican winner are associated with lower levels of FX volatility. Thus, the market players seem to favor Republican candidates which is consistent with the partisan theory (Hibbs 1977, 1986): Republican administrations have historically been recorded to focus more on macroeconomic policies that aim to keep inflation under tighter control which is favorable for the US Dollar. The finding is also backed up by the existing literature that has provided evidence that the financial markets prefer Republican administrations (see e.g. Snowberg et al. 2007; Alvarez-Ramirez et al. 2012; Dettrey and Palmer 2015) although some studies have generated opposite results, too (see e.g. Santa-Clara and Valkanov 2003; Goodell and Vähämaa 2013).

Thirdly, my empirical findings provide evidence that the FX volatility tends to be higher during the elections when the control shifts between the political parties – which happen to be the same situations in which there is no incumbent candidate running for the presidency. Various studies have perceived similar trends (see e.g. Bialkowski et al. 2008; Smales 2014). However, the findings of Snowberg et al. (2007) from the US stock market indicate that incumbency of a political party plays only a secondary role in creating the markets shock after the partisan effect. My findings support the notion in the sense that the changing probabilities for the party out-of-power do not appear to affect the FX volatility in a statistically significant way whereas the changing odds for Republican presidents do in the majority of the models.

Overall, my findings support the assumption that the evolvement of public opinion about the election outcome is reflected to at least some extent to the FX market in form of anxiety. However, since most of the variables I use to measure political uncertainty are built ex post, my two most important findings from a practical perspective are perhaps that (1) the more uncertainty there is about the election outcome, the higher the FX volatility tends to be, and that (2) the conditional volatility of the US dollar appears to

be higher during the elections when a change of the president is inevitable. I also acknowledge that the implications that are drawn from my empirical results cannot be generalized excessively as my sample is limited to seven US presidential elections due to the availability of the prediction market data. Therefore, future studies that examine the relationship between election uncertainty and FX volatility could broaden the sample size. In addition, in light of the recent political development in the Western World and the rise of populism, it would be of interest to analyze separately (1) the volatility reactions during ordinary elections, and (2) the market shocks created by groundbreaking elections. The mere probabilities of an outcome do give some indication about the level of political uncertainty, but the shocks that the political uncertainty creates to financial markets are likely to be larger when an election might lead to larger changes in the economic policy. In other words, the same level changes in the candidates' odds might lead to stronger market reactions in some elections than in other depending on the expectations about the candidates' economic policies. The incumbency effect is just an example of the larger phenomenon.

In any case, the findings of my thesis provide new evidence on how the foreign exchange is affected by election uncertainty, and as long as there are political elections, it is worthwhile to aim for a deeper comprehension about the reactions generated by the uncertainty that is a part of them – for as John Allen Paulos has stated: "Uncertainty is the only certainty there is, and knowing how to live with insecurity is the only security."

References

Alvarez-Ramirez, J.; Rodriguez, E.; Espinosa-Paredes, G. (2012). A partisan effect in the efficiency of the US stock market, *Physica A: Statistical Mechanics and its Applications, 391(20),* pp. 4923-2932

Berg, J.E.; Rietz, T.A. (2014) Market design, manipulation, and accuracy in political prediction markets: Lessons from the Iowa Electronic Markets, *Political Science & Politics, 47(2),* pp. 293-296

Bialkowski, J.; Gottschalk, K.; Wisniewski, T.P. (2008). Stock market volatility around national elections, *Journal of Banking & Finance, 32,* pp. 1941-1953

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics, 32,* pp. 307-327

Cao, H.; Han, B. (2011). Fear of the Unknown: Familiarity and Economic Decisions, *Review of Finance, 15(1),* pp. 173-206

Chrétien, S.; Coggins, F. (2009). Election outcomes and financial market returns in Canada, *North American Journal of Economics and Finance, 20*, pp. 1-23.

Dettery, B.J.; Palmer, H.D. (2015). Partisan difference in the distributional effects of economic growth: Stock market performance, unemployment, and political control of the presidency, *Journal of Elections, Public Opinion & Parties, 21,* pp. 1-16

Fair, R.C. (2009). Presidential and Congressional Vote-Share Equations, *American Journal of Political Science, 53(1),* pp. 55-72

Goddard, J.; Kita, A.; Wang, Q. (2015). Investor attention and FX volatility, *Journal of International Financial Markets, Institutions & Money, 38,* pp. 79-96

Goodell, J.W.; Vähämaa, S. (2013). US presidential elections and implied volatility: The role of political uncertainty, *Journal of Banking and Finance, 37,* pp. 1108-1117

Goodell, J.W.; McGroarty, F.; Urquhart, Andrew. (2015). Political uncertainty and the 2012 US presidential election: A cointegration study of prediction markets, polls and a stand-out expert, *International Review of Financial Analysis, 42,* pp. 162-171

Hibbs, D. (1977). Political parties and macroeconomic policy, *American Political Science Review, 71,* pp. 1467-1487

Hibbs, D. (1986). Political parties and macroeconomic policies and outcomes in the United States, *American Economic Review, 76,* pp. 66-70

Johnson, R.R.; Chittenden, W.; Jensen, G. (1999) Presidential politics, stocks, bonds, bills and inflation, *Journal of Portfolio Management, 26,* pp. 27-31

Julio, B.; Yook, Y. (2012). Political uncertainty and corporate investment cycles, *The Journal of finance, 67,* pp. 45-83

Lam, K.-P.; Ng, H.S. (2006). How does sample size affect GARCH Models? *Conference Paper: Proceedings of the 2006 Joint Conference on Information Sciences Oct 8-11 2006*

Lobo, B.J.; Tufte, D. (1998). Exchange rate volatility: Does Politics Matter?, *Journal of Macroeconomics, 20(2),* pp. 351-365

Miller, M.; Weller, P.; Zhang, L. (2002). Moral hazard and the US stock market: Analyzing the "Greenspan put", *The Economic journal, 112(478),* pp. C171-C186

Nordahaus, W.D. (1975). The political business cycle, *Review of Economic Studies, 42,* pp. 169-190

Pástor, L.; Veronesi, P. (2013). Political uncertainty and risk premia, *Journal of Financial Economics, 110*, pp. 520-545.

Santa-Clara, P.; Valkanov, R. (2003). The Presidential puzzle: Political Cycles and the Stock Market, *Journal of Finance, 58 (5),* pp. 1841-1872

Smales, L.A. (2014). Political uncertainty and financial market uncertainty in an Australian context, *Journal of International Financial Markets, Institutions & Money, 32,* pp. 415-435

Snowberg, E.; Wolfers, J.; Zitzewitz, E. (2007). Partisan impacts on the economy: evidence from prediction markets and close elections, *Quarterly Journal of Economics, 122(2),* pp. 807(24)

Tufte, E.R. (1978). *Political control of the economy*. Princeton,: Princeton University Press